REMARKS

35 U.S.C. §101 Issue

Claims 1-19 are pending in the application. Claims 1-19 have been rejected under 35 U.S.C. §101 as being directed to non-statutory subject matter.

The applicant's claims are related to neural networks. Claims 1-12 are directed to neural networks and claims 13-19 are directed to methods of training neural networks. Claims 1-12 are product-by-process claims. The product is a neural network and the process is a method of training the neural network.

Neural networks are signal processors and as such they receive input signals and process the input signals to produce output signals which are the output of the neural networks (See applicants specification ¶ 5, 2nd sentence). In this regard, neural networks are not dissimilar to other familiar and clearly statutory signal processors such as low-pass filters, band-pass filters and demodulators.

The patent office has an established practice recognizing that neural networks are statutory subject matter and has established a hierarchy of 30 subclasses in class 706 to classify issued neural network patents. Moreover in the first neural network example found in the EXAMINATION GUIDELINES FOR COMPUTER-RELATED INVENTIONS TRAINING MATERIALS DIRECTED TO BUSINESS, ARTIFICIAL INTELLIGENCE, AND MATHEMATICAL PROCESSING APPLICATIONS (Examination Guidelines) issued by the USPTO after 1996, the USPTO has indicated that properly drafted claims covering training of neural networks are statutory.

The Office Action has rejected claims 1-19 because, inter alia, they are asserted to recite "mathematical abstraction and/or algorithm" {emphasis added}. In as much as

certain patent law jurisprudence has dealt with "mathematical abstractions" and "algorithms" separately, applicant respectfully requests that in any future rejection under 35 U.S.C. §101, the examiner specify whether the applicants claims are being rejected as reading on "mathematical abstractions" or "algorithms" or both.

"Mathematical Abstraction"

One assertion made in the Office Action is that the applicant's claims are directed to a "mathematical abstraction". Set Theory or the Fundamental Theorem of Calculus may be considered to be "mathematical abstractions" but an apparatus for processing signals such as a neural network is not a "mathematical abstraction". The utility of neural networks for processing signals is well known to workers in various advanced fields of electrical engineering. As indicated in the applicant's specification neural networks, including the applicant's claimed neural network can be implemented using analog or digital electronics and in either form the claimed neural network is not a "mathematical abstraction". (It is noted that the applicant's independent claims are not so narrow as to be restricted to analog or digital electronics. One of ordinary skill in the art can implement the applicant's claimed neural networks using analog or digital circuitry.)

"Algorithm"

The applicant will assume that the claims stand rejected under 35 U.S.C. §101 as reading on an algorithm. The neural network recited in claim 1-12 can (optionally but not necessarily) be implemented as a processor programmed by a program that embodies an "algorithm" and the method recited in claims 13-19 can also be carried out using a processor programmed by a program that embodies an "algorithm". However,

the fact that the claims recite subject matter that can embody an algorithm does not mean that the claims are not statutory under 35 U.S.C. § 101.

In the case of the neural networks claimed in claims 1-12, such an algorithm is not abstract and detached from practical utility, rather it is part of a signal processor that as such has practical utility.

In recent decisions the CAFC has addressed the issue of whether algorithms are excluded from patentability and concluded that they are not, as a rule, excluded under 35 U.S.C. §101. For example, In *AT&T v. Excel* 172 F. 3d 1352 (50 U.S.P.Q. 2d 1447) the CAFC acknowledged the relation between software and algorithms that was pointed out by Justice Stevens in his dissenting opinion *Diamond v. Diehr* 450 U.S. 175, while holding that the recitation in claims of a mathematical algorithm in claims is not dispositive as to the patentability under §101. The CAFC explained in *AT&T v. Excel* that the proper focus in determining patentability of software inventions under 35 U.S.C. §101 is whether "the algorithm-containing invention, as a whole, produces a tangible, useful result." {Emphasis added} The tangible result produced by a neural network is an output signal.

Computer Related Manufacture

In rejecting the applicants claims under 35 U.S.C. §101 the office action also asserted that the claims 1-12 were drawn to a "computer related manufacture". The applicant has found no precedent for rejecting a patent application under 35 U.S.C. §101 because the claims were drawn to a "computer related manufacture". The only patent law related document that the applicant has found that uses the term "computer related manufacture" is the "*Legal Analysis to Support Proposed Examination*

Guidelines for Computer-Implemented Inventions" issued by the USPTO and dated October 3, 1995. These guidelines appear to have been issued as a follow up to the commissioners concessions in *In re Beauregard*, 53 F.3d 1583 which related to whether claims directed to a computer readable medium storing software is statutory subject matter under 35 U.S.C. §101. These guidelines did not exclude "computer related manufactures" from patentability under 35 U.S.C. §101, rather the guidelines affirmed the patentability of certain "computer related manufactures". More importantly, the legal criteria set forth in the guidelines that uses the term "computer related manufacture", is not directly relevant to the applicant's claims, because the applicants claims 1-12 are not Beauregard type claims. Rather claims 1-12 are directed to a neural networks-a type of signal processor that can be implemented as dedicated hardware or a programmed processor. Applicant notes that there is a distinction under the patent jurisprudence related to 35 U.S.C. §101 between Beauregard type claims and claims covering a programmed processor or other electronic hardware. For example, in In re Alappat ("Alappat") 33 F. 3d 1545 (31 U.S.P.Q.2d 1545) the CAFC held that "...programming creates a new machine, because a general purpose computer in effect becomes a special purpose computer once it is programmed to perform particular functions pursuant to instructions from program software"

Data Structure

The office action addresses whether the applicants claims 1-12 are patentable as data structure claims. Applicants claims are not properly construed as data structure claims and thus patentability under 35 U.S.C. §101 does not hinge on whether or not

they meet or do not meet judicially created requirements for patentability of data structure claims. Applicants claims 1-12 are directed neural networks-a type of signal processor not data structures.

Physical Transformation-Useful, Concrete and Tangible Result

In rejecting applicants claims 13-19, the office action also asserts that claims 13-19 recited no associated physical transformation, however, recitation of a physical transformation is not required for patentability under 35 U.S.C. §101. In *AT&T v. Excel* 172 F. 3d 1358 the CAFC stated:

> "The notion of "physical transformation" can be misunderstood. In the first place, it is not an invariable requirement, but merely one example of how a mathematical algorithm may bring about a useful application."{emphasis added}

In rejecting claims 13-19, the examiner quoted the last step recited in claim 13 and argued that the recited step is not a "useful, concrete, and tangible real-world result". (It is noted that "real world" is an insertion that is absent in the patent law jurisprudence.) The recited step that is quoted in the office action is one of several steps recited in claim 13 which can optionally, as shown most clearly in FIG. 7, be repeated recursively. The quoted step is not the "useful, concrete, and tangible result" produced by the method recited in claims 13-19.

The "useful, concrete, and tangible result" is a trained neural network. The preambles of claims 13-19 unambiguously identify the purpose of the recited methods which is training a neural network. A trained neural network is useful in many electrical engineering systems including, for example, control systems (mentioned in the

specification) and pattern recognition. The trained neural network is the result of all of the recited steps.

General Purpose Nature of Neural Networks

Various practical uses of neural network signal processors are known. The applicant's specification mentions control applications as one practical use of neural networks (See ¶ 26). Another broad category of common applications of neural networks is in pattern recognition which includes facial recognition, hand writing recognition and voice recognition.

Many patents are directed to components or sub-systems that are not independently useful to an end user. For example a transmission has no utility without a prime mover, e.g., an engine to drive its input and equipment, e.g., and automobile that is driven by the output of the transmission. Similarly, in the field of electrical engineering low pass filters and demodulators are not, in isolation, useful to end users. However, they are vital parts of apparatuses e.g., cellular telephones that are eminently useful to end users. Despite the lack of utility for such components or sub-systems, in isolation, such components and sub-systems are statutory under 35 U.S.C. §101. The standards of 35 U.S.C. §101 and 35 U.S.C. §112 are such that one can obtain a patent on a component or sub-system without describing in the patent specification the details of larger systems in which the component or sub-system is used. A patent on a carburetor is unlikely to include any information on the number and arrangement of cylinders in engines in which the carburetor may be used. Person's of ordinary skill in the art recognize the ordinary uses of components or sub-systems and it is impractical

to cover the details and numerous variations of the larger systems. Neural networks have been under development since that the 1970's and known uses exist in various fields including control systems and pattern recognition (e.g., facial recognition). Thus, the applicant has not described in detail larger systems in which the applicant's claimed neural networks can be incorporated.

The USPTO own Examination Guidelines cited above support the patentability of a neural network training method where there is no teaching of a use of the neural network in a specific application. To wit, the hypothetical specification text for the neural network example in the Examination Guidelines referenced above states:

> "There are a wide range of functions which may be carried out by the ultimate end user of the neural network. The function will dictate the criteria upon which the network specifications must be established. The process will vary upon the selection of the criteria. The disclosed methodology is the basic framework from which most functionalities may be established from an appropriate training set." {emphasis added}

The hypothetical specification text includes no further information regarding a specific technical application of the neural network.

Different Embodiments

During the last 20 years advanced signal processing has migrated, to a large extent, to Digital Signal Processing (DSP). Whereas in the past electronic circuits were analyzed and described using mathematics, Digital Signal Processing works by directly operating on signals with mathematical functions. Low pass filters and demodulators can and often are implemented using programmed Digital Signal Processing chips. A clearly statutory analog filter that comprises a network of inductors, capacitors and resistors, is no less statutory because it can be described by a mathematical function.

Moreover, an equivalent digital filter implementation such as a Digital Signal Processor (DSP) programmed with mathematical functions to process signals is no less statutory. Similarly, the neural networks recited in applicants claims 1-12 can be implemented using programmed Digital Signal Processor chips. However, applicants claims 1-12 are not limited in respect to whether the recited neural networks are implemented using programmed DSP chips or analog circuits. Thus, the applicants claims 1-12 recite a type of signal processor that can be implemented using analog or digital electronics and in the latter case could be implemented as application specific logic circuits and/or using a programmed processor. Applicant concedes that the method steps recited in applicants claims would likely be implemented using a programmed digital computer, but implementation using an analog computer is not excluded.

The neural network recited in claim 1-12 can (optionally but not necessarily) be implemented as a processor programmed by a program that embodies an "algorithm" and the method recited in claims 13-19 can also be carried out using a processor programmed by a program that embodies an "algorithm". However, the fact that the claims recite subject matter that can (not necessarily) involve an algorithm does not mean that the claims are not statutory under 35 U.S.C. § 101. In the case of the applicant's claimed neural network, such an algorithm is not abstract and detached from practical utility, rather it is part of a signal processor that has practical utility. The applicant's specification also mentions hardware embodiments of the neural network claimed in claims 1-12. See for example the first sentence of paragraph 27 which reads:

> "In an electrical hardware implementation of the invention, the directed edges (e.g., 120, 122) are suitably embodied as attenuating and/or amplifying circuits."

and the last sentence of paragraph 33 which reads:

> "In a hardware implementation of the neural network, the first processing nodes and other processing nodes are implemented in digital or analog circuitry or a combination thereof."

Claim Terminology

Applicant has used the terms "directed edge" and "node" in the claims. Although such terms may be unfamiliar or connote abstract subject matter to some, they are understood (especially in view of the specification) by persons of ordinary skill in the pertinent art to corresponds to hardware circuits or functions implemented by a programmed processor.

For the reasons set forth above applicant submits that claims 1-19 recite subject matter that is statutory under 35 U.S.C. §101 and withdrawal of the rejection is respectfully solicited. If the examiner finds the case to be other than in a condition for allowance, the examiner is invited to contact the undersigned in order to address any remaining issues in order to advance the prosecution.

Respectfully submitted,

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